CLAIMS

What is claimed is:

1. A computer-implemented method for approximating a function of an input argument, comprising:

selecting one of a plurality of breakpoints, such that a reduced argument for the function is less than a predetermined value; and

evaluating an approximate function of the reduced argument, including accessing a look-up table based on the selected breakpoint to obtain a value of a term in the approximate function,

wherein the look-up table has at least one breakpoint for which the reduced argument can be computed without roundoff error when the input argument is close to a root of the function.

2. The method of claim 1 wherein the function is $\log_b(X)$.

3. The method of claim 2 further comprising:

representing X in the floating point form Y^*G^k where Y is greater than or equal to 1, and wherein the reduced argument is $Z=C^*(Y^*B_j-1)$ where C is a function of $\log_b(e)$, and evaluating the approximate function includes determining $\log_b(1/B_j)$ using the look-up table and determining $\log_b(X)$ as an arithmetic combination of at least $k^*\log_b(2)$, $\log_b(1/B_j)$, and $\log_b(1+Z/C)$.

4. The method of claim 3 wherein $Y<=2$ and the look-up table is modified such that $B_0=1$ and $B_N =1/2$.

5. The method of claim 3 wherein $\log_b (1/B_j)$ is given by the look-up table as at least two lower precision values $T_{j,hi}$ and $T_{j,lo}$ whose sum equals $\log_b (1/B_j)$, $\log_b (2)$ is given by at least two lower precision values L_{hi} and L_{lo} whose sum equals $\log_b (2)$, and Z is given by at least two lower precision values Z_{hi} and Z_{lo} whose sum equals Z.

6. The method of claim 5 wherein $\log_b (X)$ is approximated by $A_1+A_2+Z_{lo}$, where A_1 is $k^*L_{hi}+T_{j,hi}+Z_{hi}$, A_2 is $k^*L_{lo}+T_{j,lo}+P$ and P is $\log_b (1+Z/C)-Z$.

7. The method of claim 6 wherein if k*N+j=0 for the breakpoint, then $\log_b(X)$ is approximated by $(A_1+Z_{lo})+A_2$.

8. The method of claim 7 wherein $\log_b(X)$ is otherwise given by $A_1 + (A_2+Z_{lo})$.

9. The method of claim 3 wherein the predetermined value is proportional to 1/(2*N).

10. The method of claim 9 wherein $k*L_{hi}+T_{j,hi}$ can be represented without roundoff error for all valid values of k,j.

11. The method of claim 10 wherein $T_{0,hi}=T_{0,lo}=0$ and $T_{N,hi}=L_{hi}$, $T_{N,lo}=L_{lo}$.

12. An article of manufacture, comprising:

a machine readable medium having instructions stored therein that can be executed by a processor to approximate a function of an input argument by selecting one of a plurality of breakpoints, such that a reduced argument for the function is less than a predetermined value, and evaluating an approximate function of the reduced argument including accessing a look-up table based on the selected breakpoint to obtain a value of a term in the approximate function, wherein the look-up table has at least one breakpoint for which the reduced argument can be computed without roundoff error when the input argument is close to a root of the function.

13. The article of manufacture of claim 12 wherein the function is $\log_b(X)$.

14. The article of manufacture of claim 13 wherein the medium has further instructions for representing X in the floating point form $Y*G^k$ where Y is greater than or equal to 1, and wherein the reduced argument is $Z=C*(Y*B_j-1)$ where C is a function of $\log_b(e)$, and evaluating the approximate function includes determining $\log_b(1/B_j)$ using the look-up table and determining $\log_b(X)$ as an arithmetic combination of at least $k*\log_b(2)$, $\log_b(1/B_j)$, and $\log_b(1+Z/C)$.

15. The article of manufacture of claim 14 wherein Y<=2 and the look-up table is modified such that $B_0=1$ and $B_N=1/2$.

16. The article of manufacture of claim 13 wherein $\log_b (1/B_j)$ is given by the look-up table as at least two lower precision values $T_{j,hi}$ and $T_{j,lo}$ whose sum equals $\log_b (1/B_j)$, $\log_b (2)$ is given by at least two lower precision values L_{hi} and L_{lo} whose sum equals $\log_b (2)$, and Z is given by at least two lower precision values Z_{hi} and Z_{lo} whose sum equals Z.

17. The article of manufacture of claim 16 wherein $\log_b (X)$ is approximated by $A_1+A_2+Z_{lo}$, where A_1 is $k*L_{hi}+T_{j,hi}+Z_{hi}$, A_2 is $k*L_{lo}+T_{j,lo}+P$ and P is $\log_b (1+Z/C)-Z$.

18. The article of manufacture of claim 17 wherein if k*N+j=0 for the breakpoint, then $\log_b (X)$ is approximated by $(A_1+Z_{lo})+A_2$.

19. The article of manufacture of claim 18 wherein $\log_b (X)$ is otherwise given by $A_1 + (A_2+Z_{lo})$.

20. The article of manufacture of claim 14 wherein the predetermined value is proportional to 1/(2*N).

21. The article of manufacture of claim 20 wherein $k*L_{hi}+T_{j,hi}$ can be represented without roundoff error for all valid values of k,j.

22. The article of manufacture of claim 21 wherein $T_{0,hi}=T_{0,lo}=0$ and $T_{N,hi}=L_{hi}$, $T_{N,lo}=L_{lo}$.

23. A computer system comprising:

a processor coupled to a non-volatile storage device, the storage device contains instructions that when executed by the processor approximate a function of a number, by selecting one of a plurality of breakpoints, such that a reduced argument for the function is less than a predetermined value, and evaluating an approximate function of the reduced argument including accessing a look-up table based on the selected breakpoint to obtain a value of a term in the approximate function, wherein the look-up table has at least one breakpoint for which the reduced argument can be computed without roundoff error when the input argument is close to a root of the function.

24. The computer system of claim 23 wherein the function is $\log_b(X)$.

25. The computer system of claim 24 wherein the storage device has further instructions that when executed by the processor represent X in the floating point form $Y*G^k$ where Y is greater than or equal to 1, and wherein the reduced argument is $Z=C*(Y*B_j-1)$ where C is a function of $\log_b(e)$, and evaluating the approximate function includes determining $\log_b(1/B_j)$ using the look-up table and determining $\log_b(X)$ as an arithmetic combination of at least $k*\log_b(2)$, $\log_b(1/B_j)$, and $\log_b(1+Z/C)$.

26. The computer system of claim 25 wherein $\log_b(1/B_j)$ is given by the look-up table as at least two lower precision values $T_{j,hi}$ and $T_{j,lo}$ whose sum equals $\log_b(1/B_j)$, $\log_b(2)$ is given by at least two lower precision values L_{hi} and L_{lo} whose sum equals $\log_b(2)$, and Z is given by at least two lower precision values Z_{hi} and Z_{lo} whose sum equals Z.

27. The computer system of claim 26 wherein $\log_b(X)$ is approximated by $A_1+A_2+Z_{lo}$, where A_1 is $k*L_{hi}+T_{j,hi}+Z_{hi}$, A_2 is $k*L_{lo}+T_{j,lo}+P$ and P is $\log_b(1+Z/C)-Z$.

28. The computer system of claim 23 wherein the processor has a hardware architecture that is deeply pipelined and in which branch mispredictions cause a significant performance penalty.

29. The computer system of claim 28 wherein the processor is one of a plurality of IA-32 series of processors by Intel Corp.